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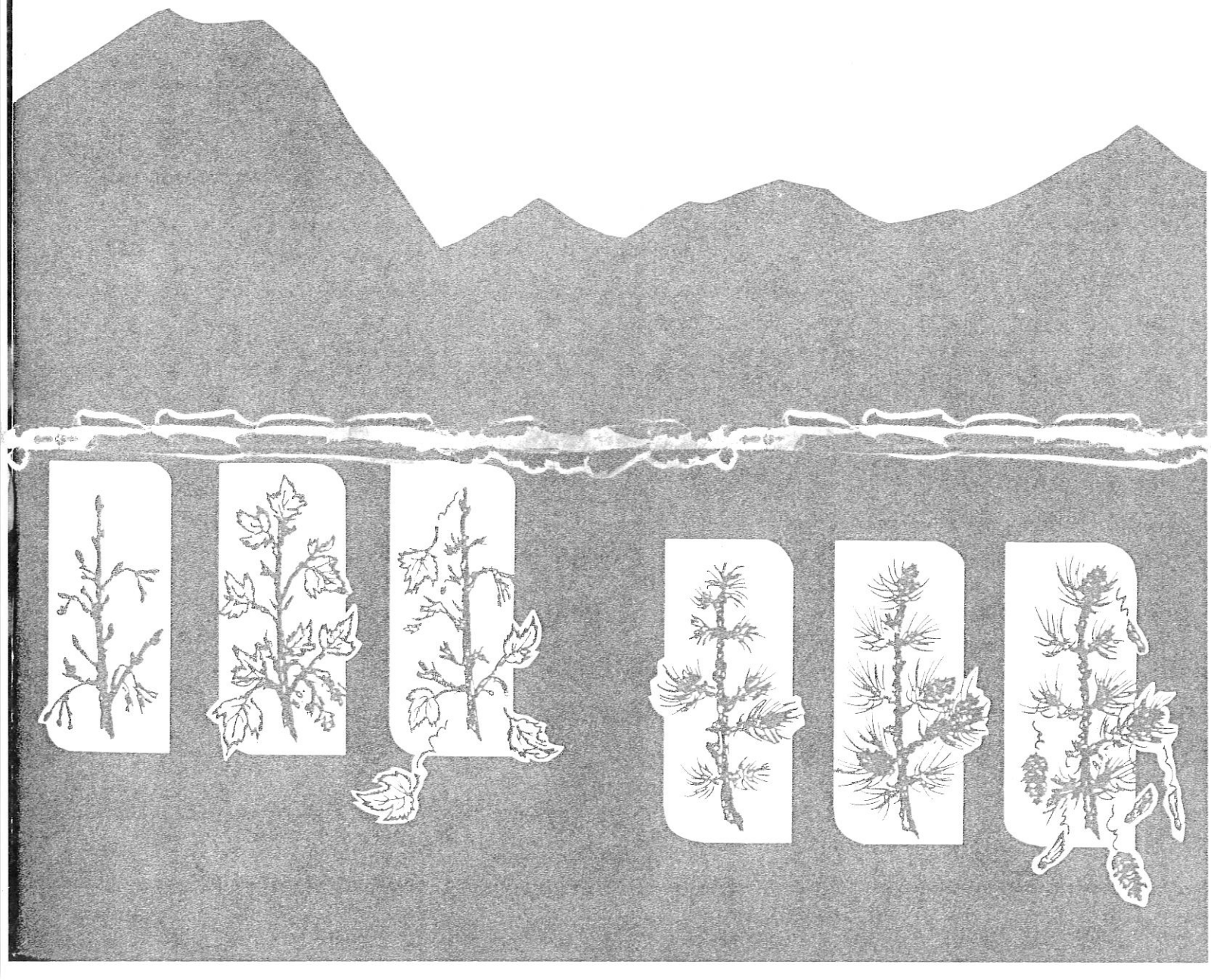
USDA Forest Service Research Paper INT-259
Intermountain Forest and Range Experiment Station
U.S. Department of Agriculture, Forest Service



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October 1980

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ACKNOWLEDGMENTS

We acknowledge the many people involved in the conduct of this study in the 1920's and 1930's, many of whom are deceased. However, we feel that special acknowledgments are due to Robert Weidman, Irvine Haig, Elers Koch, Lyle Watts, Lincoln Ellison, and Charles Wellner for the design, administration, and conduct of the study reported here.

RESEARCH SUMMARY

This paper presents 10 years of phenological observations of common forest flora of the Northern Rockies. Descriptions of important phenological events and earliest, latest, and average dates of their occurrence are included. Phenological data were collected on many National Forests, as well as Yellowstone and Glacier National Parks, at more than 40 locations ranging from eastern Montana to northern Idaho. Summaries include 50 forest species--13 conifers, 22 hardwood trees and shrubs, and 15 herbaceous plants. Six summary tables are used to stratify the phenological information for the above three vegetation groupings both east and west of the Continental Divide. This phenological information has the potential for much practical application where timing of events such as leafing, pollination, cone opening, and others are key to scheduling specific management and research activities.

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INTRODUCTION

Phenology--many foresters and botanists talk about it, but few do anything about it. Perhaps it has been a function of low demand, difficulty of making meaningful measurements, failure to see its application, or a host of other reasons. Unfortunately, much of the phenological data collected have been for specific and immediate purposes, such as range condition or fire danger. Little has been published nationally or in the Northern Rockies. Although some phenology information is available for the Northern Rockies, no comprehensive data for the mountain forest flora have been readily available.

The mix of forest uses, priorities, and management intensities is changing in the Northern Rockies. Lands are being managed for an increasingly wider range of resources, requiring a greater breadth and depth of knowledge about vegetation. As a result, the whole vegetation complex is assuming more importance, regardless of the resource values being featured in management.

Not only is the management activity itself important, but in many cases, the timing of the activity is important. This is not something we recently discovered. R. H. Weidman, who was primarily responsible for this study, said in his USDA Forest Service Northern Rocky Mountain Forest Experiment Station study plan of 1928:

> Knowledge of the phenological events of the forest are essential to a thorough understanding and organization of forestry operations. It is particularly desirable to know the time of leafing and pollination, the time of cone opening and seed dispersal, the time that diameter and leader growth commences and ends. It is, moreover, as important to know the time that seed germinates in natural locations as in nurseries. To properly understand inflammability conditions in connection with fire protection, it is important to know also when shrubs become succulent, when the principal perennials cover the ground, and when they wither and die.
>
> The practical value of phenological observations has long been recognized in grazing management to determine range readiness and other matters. The forest pathologist and the forest entomologist have to correlate the seasonal development of host plants with the behavior of the rust or insect parasite.

Now, because of broadening management and research perspectives, demand is accelerating for information concerning phenology of forest species found in the Northern Rockies. We have had to search the archives in attempts to find the data. The archives we have looked to most frequently are an extensive set of phenological data collected on forest lands in the Northern Rockies from 1928 to 1937.

For various reasons, these data were never published and few people are aware they even exist. We feel that even though the collection period overlapped the Roaring 20's and the Great Depression, the research is just as valuable now as then. Computational techniques not available at the culmination of the study in 1937 now make it possible to make the data more meaningful than practicably possible at that time.

Many phenological studies in this century have attempted to relate phenological events to various meteorological data. Fire-weather records, mainly temperature, were available for many of the locations used for the 1928 to 1937 phenological data. Ellison[1] attempted to link the weather and phenology data, but his results were disappointing in that no real meaningful relationships were detected.

As a result, we decided to present what we feel are the strengths of the study--straightforward summaries of the data including earliest, latest, and average dates, as well as standard errors (in days) for phenological events in the Northern Rockies. We attempted no further analyses of weather-phenological relationships.

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[1]The report of Ellison's analyses is on file at the Intermountain Forest and Range Experiment Station, Forestry Sciences Laboratory, Bozeman, Montana.

METHODS

Study Areas

In 1928, 44 phenological observation stations were established throughout Montana and northern Idaho, expanding to 46 in 1929. These included stations on 18 National Forests, at Savenac Nursery in western Montana, Priest River Experimental Forest in northern Idaho, and Yellowstone and Glacier National Parks. Geographically, they ranged from the Custer National Forest in eastern Montana to the Kaniksu National Forest in northwest Idaho, an east-west distance of about 700 air miles (1 100 km). Elevationally, they averaged about 3,200 ft (975 m) and ranged from 2,200 to 4,150 ft (670-1 265 m) west of the Continental Divide. East of the Divide the average was about 5,300 ft (1 615 m) with a range of 3,200 to 6,750 ft (675-2 060 m). By 1930, 35 of these stations were still reporting. According to Weidman, "Due to the need for relief of ranger work loads, observations were abandoned on 12 forests between 1932 and 1934." The number of stations was reduced again in 1935, but a concentrated effort remained to maintain some vegetative stratification in the white pine type (figs. 1, 2), the ponderosa pine type (fig. 3), the larch-fir type (fig. 4), and the lodgepole pine type (fig. 5). By the last year of this study, 1937, observations were still being conducted on the Bitterroot, Clearwater, Gallatin, Flathead, and St. Joe Forests, and at Savenac Nursery, Priest River Experimental Forest, Deception Creek Experimental Forest, and Yellowstone National Park.

As shown in figure 6, the phenological stations were not only widely dispersed geographically, but also fairly well distributed.

Data Collections

As many as 16 different phenological events were recorded at the outset of the study in 1928. During the next 10 years this was gradually reduced to the more meaningful and measurable events--10 events in the conifers, 9 in the hardwood trees and shrubs, and 11 in the herbs. Included were events such as bud burst, pollen shedding, seed fall, leaf fall, and others.[2]

At each phenological station, conifers, hardwood trees and shrubs, and herbaceous plants common to the locality were measured phenologically. In 1928, sampling included 12 conifers, 16 hardwood trees and shrubs, and 14 herbaceous species. As discussed later, this list was expanded during the following 10 years. Some stations had few species, and some had many, but none had all of the above combination of species represented.

Phenological stations were established near ranger or other forest headquarters occupied during the growing season, near a weather station, and in a spot "representative" of the forest type of the area. One or more persons at each study area were assigned to record the phenological events weekly by species. A study plan by R. H. Weidman in 1928 detailed the methods for all phenological stations, serving as a common guide for all observers. Observers selected were to be "men who have enough practical knowledge of botany to make reliable records, and who at the same time are personally interested in making observations of this sort." In reality, weekly measurements were simply not possible on all areas, and in some cases a whole season was missed because of insufficient staffing or higher priority work schedules.

Analysis Methods

In 1933, Ellison prepared an internal report of the results of 5 years of data from six phenology stations in forests of the white pine type. He searched for relationships to illustrate "fundamental principles as to the relation of vegetative events and the causal factors of air and soil temperature." He felt unsuccessful in this effort. As a result, nothing was published. Subsequent internal discussions and reports by Watts, Koch, Haig, and Weidman pointed out that the "practical usefulness of simply knowing earliest, latest, and average dates of beginning and ending of vegetative activities" was the most important information from the study. Again, nothing was formally published and interest in phenological studies apparently waned.

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[2]See the appendix for definitions of the phenological events used in this study.

Figure 1.--Phenological observations were made in the western white pine (*Pinus monticola*) forest type. This picture, taken in 1929 on Deception Creek Experimental Forest in northern Idaho, illustrates dense natural regeneration of western white pine.

Figure 2.--Phenological observations were made on a wide variety of species found in the western white pine type. These included western white pine, Douglas-fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), western hemlock (*Tsuga heterophylla*), and a wide variety of understory shrubs and herbs shown in this 1937 photo in northern Idaho.

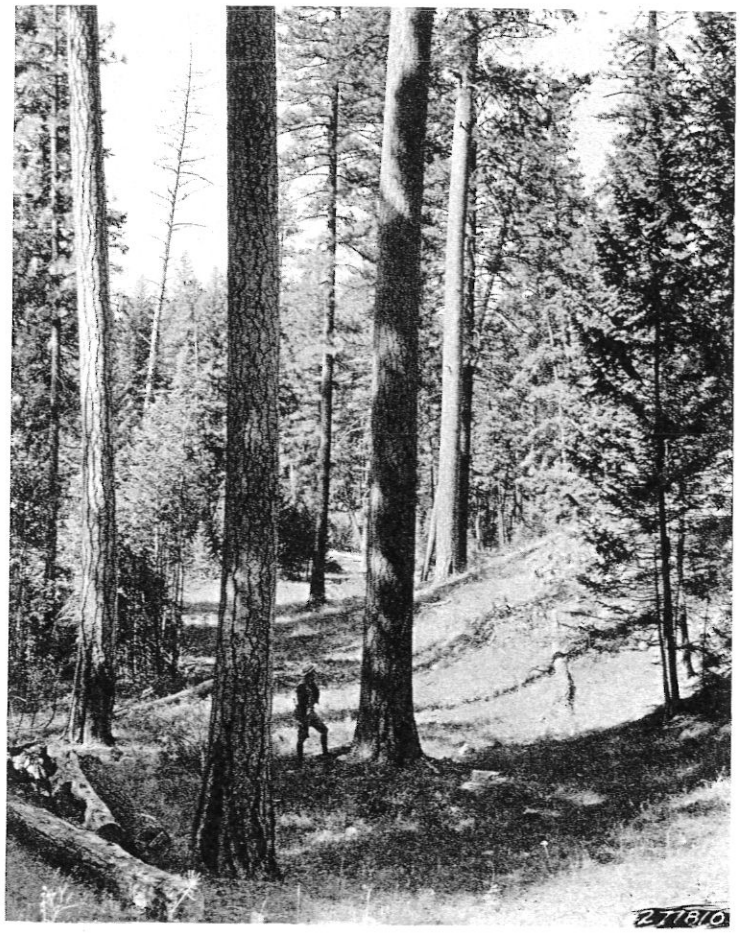

Figure 3.--Phenological observations were made in the ponderosa pine (*Pinus ponderosa*) forest type. This picture, taken in 1932 near Greenough, Montana, illustrates an old-growth ponderosa pine forest with some Douglas-fir understory.

Figure 4.--Phenological observations were made at several locations in the extensive western larch-Douglas-fir forests of the Northern Rockies. This picture, taken in the Kootenai National Forest area in northwest Montana, illustrates this forest type.

Figure 5.--Phenological observations were made in the lodgepole pine (*Pinus contorta*) type, illustrated in this picture taken in south-central Montana. Tree species included lodgepole pine, subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), and Douglas-fir (*Pseudotsuga menziesii*).

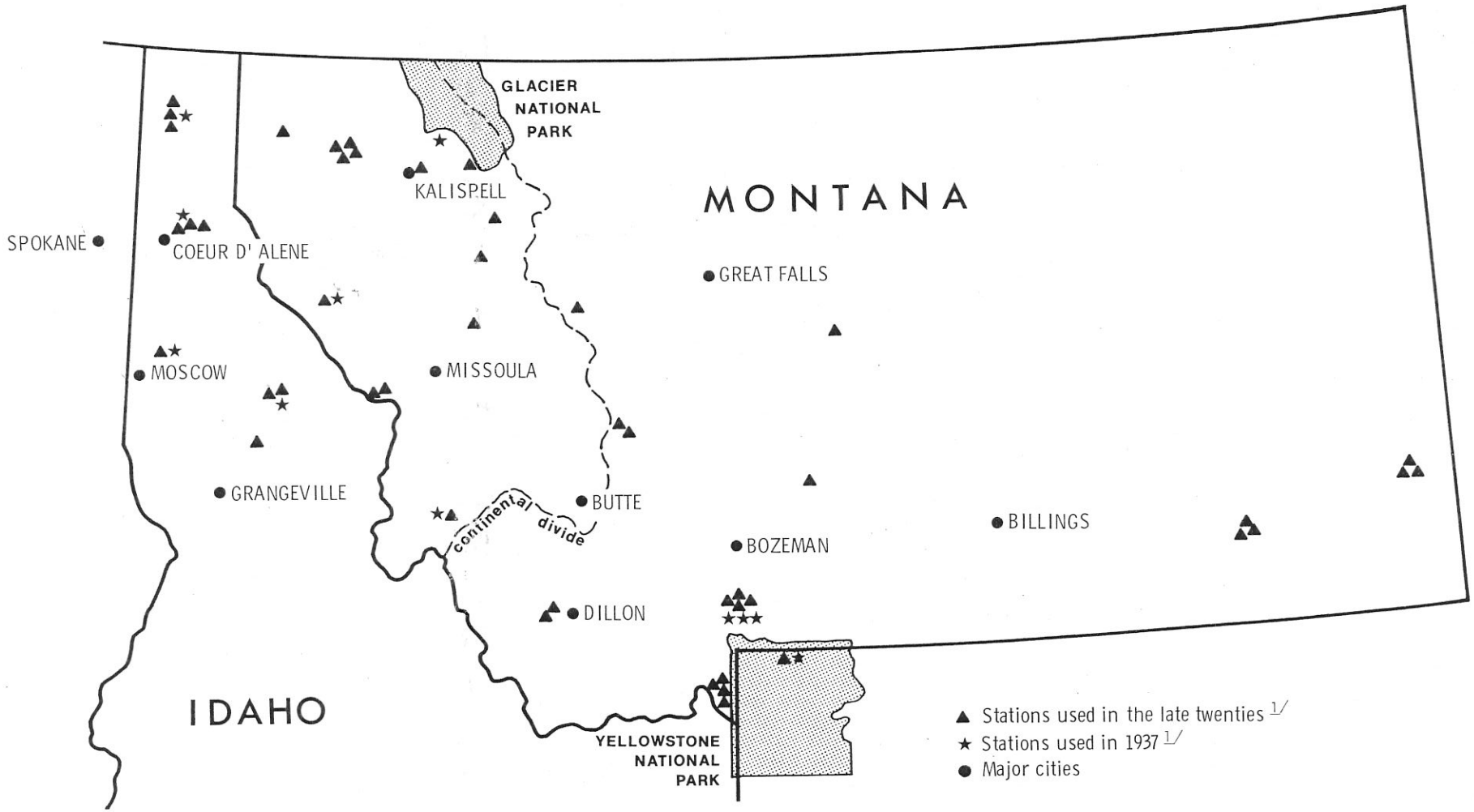

Figure 6.--Phenological stations in the Northern Rockies--1928 to 1937.

[1]These two time periods are given to demonstrate the distinction of the stations. The number and distribution of stations changed during the period of the study. Some were abandoned and not replaced--others were started at new locations--and some were used for the entire period.

Increased interest in the seventies prompted us to resurrect the data and summarize them in a form that we feel both takes advantage of the strengths of the data and puts them in usable form. As suggested by some of the earlier workers, we extracted the earliest, latest, and average dates, plus standard errors, of the phenological events. Because not all stations were read for the whole study period, not all events were recorded every year for each station, and because some stations were added and some dropped, a uniform data base was not available. So that at least some data could be summarized for nearly every event for every species, it was necessary to combine data. We chose to combine data from those stations east of the Continental Divide and the same for those west of the Divide.

RESULTS

Included in the results are 50 different species--13 conifers, 22 shrubs and hardwoods, and 15 herbaceous species. Of these, 7 conifers, 17 shrubs and hardwoods, and 7 herbs were common to and were measured on both sides of the Continental Divide. Of course, some species occur only west or east of the Divide.

The number of observations for a given species, east or west of the Divide, and in a given phenological event, was essentially a function of species abundance and distributions. Numbers ranged as high as 82 observations for starting date of lodgepole pine shoot elongation east of the Divide, to only one observation for several event-species-area combinations.

Two main geographic areas (east and west of the Continental Divide), and three plant classes (conifers, hardwood trees and shrubs, and herbs) are used to stratify the data. Figure 7 illustrates the sequence of phenological events for two common forest species of the Northern Rockies. Tables 1-6 document the average, earliest, and latest dates and the standard error for all 50 species.

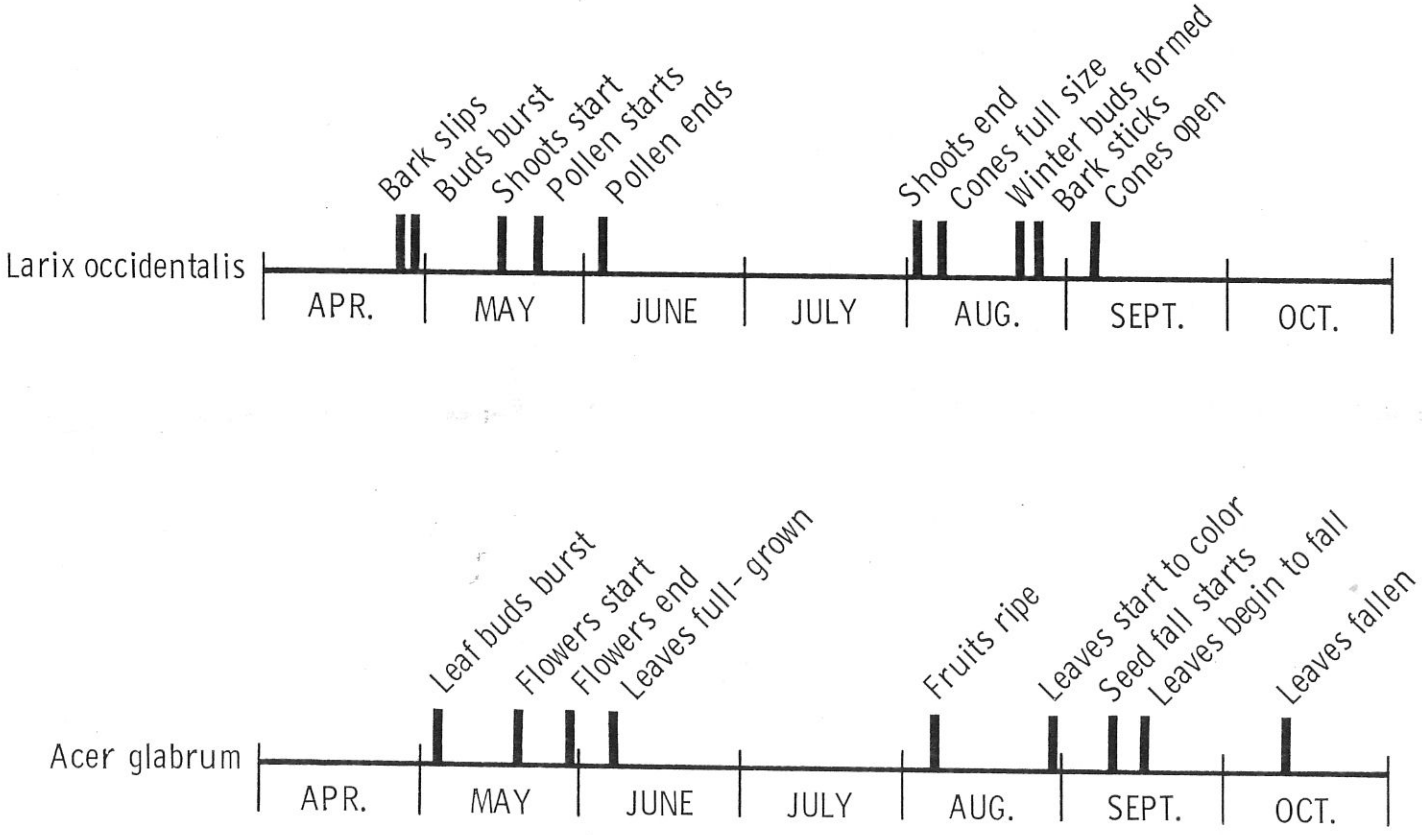

Figure 7.--An example of the time sequence of phenological events for two species west of the Continental Divide.

Table 1.--Phenological observations for conifers east of the Continental Divide in Montana and in Yellowstone National Park, 1928 - 1937.

Species	Bark slips	Shoots start	Buds burst	Pollen starts	Pollen ends	Shoots end	Bark sticks	Winter buds formed	Cones full size	Cones open
Abies lasiocarpa										
Average date	**May 22**	**June 7**	**June 14**	**June 16**	**July 4**	**Aug. 4**	**Aug. 30**	**Aug. 7**	**Aug. 29**	**Aug. 30**
Earliest date	Apr. 15	Apr. 29	May 25	May 20	June 1	June 24	Aug. 2	June 16	July 30	July 31
Latest date	June 29	July 21	July 4	July 10	July 27	Sep. 15	Oct. 1	Sep. 10	Sep. 17	Sep. 17
Standard error	5	5	3	8	9	4	5	6	7	8
Number of observations	15	21	20	7	7	19	17	18	6	5
Juniperus[1]										
Average date	**May 15**	**June 7**	**June 4**	**July 3**	**July 14**	**July 30**	**Aug. 27**	**July 4**	**Aug. 8**	
Earliest date	Apr. 25	May 20	May 20	June 25	July 10	July 21	Aug. 2	June 20	Aug. 1	
Latest date	May 27	June 22	June 26	July 14	July 20	Aug. 5	Sep. 10	Aug. 1	Aug. 16	
Standard error	5	4	3	2	2	2	4	6	4	
Number of observations	9	9	10	9	7	9	8	8	4	
Picea engelmannii										
Average date	**May 11**	**June 12**	**June 16**	**June 17**	**July 3**	**Aug. 4**	**Aug. 29**	**Aug. 3**	**Aug. 17**	**Aug. 30**
Earliest date	Mar. 5	Apr. 19	May 21	May 18	May 30	July 11	July 28	June 26	July 19	Aug. 18
Latest date	June 7	July 21	July 14	July 3	July 20	Sep. 13	Oct. 1	Sep. 17	Sep. 5	Sep. 21
Standard error	4	3	2	5	5	3	3	4	4	2
Number of observations	28	38	37	14	14	34	31	32	15	14
Pinus albicaulis										
Average date	**May 24**	**June 17**	**June 14**	**July 21**	**Aug. 5**	**July 27**	**Sep. 12**	**Aug. 24**	**Aug. 13**	**Sep. 5**
Earliest date	May 10	June 1	June 1	July 21	July 27	July 14	Aug. 30	Aug. 14	July 30	Aug. 30
Latest date	June 7	July 21	June 28	July 21	Aug. 14	Aug. 14	Oct. 1	Sep. 20	Sep. 17	Sep. 17
Standard error	14	10	5	0	9	9	10	9	12	6
Number of observations	2	5	6	2	2	3	3	4	4	3
Pinus contorta										
Average date	**May 6**	**May 16**	**May 30**	**June 17**	**July 3**	**July 22**	**Aug. 18**	**Aug. 3**	**Aug. 19**	**Sep. 3**
Earliest date	Mar. 18	Mar. 18	Mar. 18	May 17	June 1	Apr. 6	July 11	June 6	July 20	July 18
Latest date	June 7	July 21	June 28	July 14	July 27	Sep. 18	Oct. 1	Sep. 19	Sep. 25	Oct. 31
Standard error	2	3	2	1	1	3	3	3	2	3
Number of observations	71	82	80	74	70	75	76	69	58	55
Pinus flexilis										
Average date	**May 14**	**May 23**	**May 27**	**July 1**	**July 12**	**July 8**	**Aug. 28**	**July 3**	**Aug. 16**	**Aug. 27**
Earliest date	Apr. 28	Apr. 30	Apr. 30	June 20	July 4	June 22	July 21	June 11	Aug. 15	Aug. 23
Latest date	May 27	June 6	June 26	July 14	July 22	Aug. 5	Oct. 1	Aug. 16	Aug. 16	Aug. 30
Standard error	4	4	3	7	5	5	8	8	1	4
Number of observations	10	11	14	3	3	10	11	10	2	2
Pinus ponderosa										
Average date	**Apr. 28**	**May 6**	**May 24**	**June 4**	**June 17**	**July 21**	**Sep. 21**	**Aug. 30**	**Aug. 22**	**Sep. 20**
Earliest date	Mar. 22	Apr. 3	Apr. 7	May 10	May 25	Apr. 18	July 30	June 30	Aug. 1	Sep. 10
Latest date	June 5	June 20	July 31	June 23	July 5	Aug. 20	Oct. 30	Oct. 21	Oct. 2	Oct. 18
Standard error	5	4	5	3	3	6	6	10	6	4
Number of observations	24	24	24	21	21	22	19	17	11	9
Pseudotsuga menziesii										
Average date	**May 3**	**May 31**	**June 5**	**May 30**	**June 13**	**July 30**	**Aug. 16**	**Aug. 1**	**Aug. 13**	**Aug. 25**
Earliest date	Mar. 3	Apr. 25	May 10	Apr. 15	May 2	July 1	July 6	June 11	July 11	July 26
Latest date	May 31	July 1	June 22	July 3	July 25	Sep. 21	Oct. 1	Sep. 15	Sep. 15	Oct. 14
Standard error	3	3	2	4	4	3	3	3	3	4
Number of observations	49	55	57	40	39	52	51	48	41	40

[1]This juniper was not identified at that time, but it was most likely *Juniperus communis*.

Table 2.--Phenological observations for conifers in Northern Idaho and west of the Continental Divide in Montana, 1928 - 1937.

Species	Bark slips	Shoots start	Buds burst	Pollen starts	Pollen ends	Shoots end	Bark sticks	Winter buds formed	Cones full size	Cones open
Abies grandis										
Average date	**Apr. 25**	**May 18**	**May 25**	**June 4**	**June 20**	**Aug. 3**	**Aug. 27**	**Aug. 14**	**Aug. 5**	**Sep. 9**
Earliest date	Mar. 27	Apr. 19	Apr. 5	May 1	May 20	June 9	July 15	June 16	July 7	Aug. 30
Latest date	May 17	June 25	June 11	July 2	July 14	Aug. 31	Oct. 2	Oct. 11	Aug. 26	Oct. 11
Standard error	2	3	3	5	5	4	2	3	3	3
Number of observations	42	39	35	15	14	38	39	35	23	19
Abies lasiocarpa										
Average date	**May 5**	**May 14**	**May 26**	**June 18**	**June 27**	**July 29**	**Sep. 8**	**Aug. 31**	**July 30**	**Sep. 18**
Earliest date	Apr. 15	Apr. 17	May 10	June 5	June 11	June 29	Aug. 25	July 30	July 1	Sep. 9
Latest date	June 6	June 4	June 8	June 30	July 10	Sep. 2	Oct. 2	Oct. 6	Aug. 12	Oct. 10
Standard error	5	4	3	5	6	7	4	6	8	7
Number of observations	13	12	11	5	5	11	10	10	5	4
Larix occidentalis										
Average date	**Apr. 26**	**May 14**	**Apr. 30**	**May 20**	**June 3**	**Aug. 1**	**Aug. 25**	**Aug. 22**	**Aug. 6**	**Sep. 4**
Earliest date	Mar. 12	Apr. 10	Mar. 20	Apr. 26	May 10	June 18	July 15	July 11	July 2	July 31
Latest date	June 3	July 2	June 11	June 29	July 14	Sep. 6	Oct. 2	Oct. 11	Sep. 11	Sep. 30
Standard error	3	3	3	6	7	3	3	4	4	3
Number of observations	43	40	41	14	12	40	38	35	24	22
Picea engelmannii										
Average date	**May 12**	**May 18**	**May 27**	**June 1**	**June 7**	**Aug. 6**	**Aug. 30**	**Aug. 23**	**Aug. 6**	**Sep. 8**
Earliest date	Apr. 12	Apr. 18	May 5	Apr. 26	May 12	June 9	July 23	June 14	June 20	Aug. 11
Latest date	Oct. 2	June 21	July 10	June 11	May 12	July 11	Oct. 2	Oct. 11	Sep. 24	Oct. 5
Standard error	5	3	2	6	5	7	3	4	5	3
Number of observations	47	40	40	16	15	39	36	36	23	23
Pinus albicaulis[1]										
Average date	**Apr. 20**	**Apr. 17**	**May 4**			**July 4**	**Aug. 7**	**June 27**		
Earliest date	Apr. 6	Apr. 6	Apr. 18			June 4	July 26	June 9		
Latest date	May 3	Apr. 29	May 21			July 20	Aug. 21	July 28		
Standard error	6	5	7			10	6	11		
Number of observations	4	4	4			4	4	4		
Pinus contorta										
Average date	**Apr. 26**	**May 4**	**May 17**	**June 6**	**June 19**	**July 27**	**Aug. 24**	**Aug. 14**	**July 29**	**Sep. 7**
Earliest date	Mar. 12	Mar. 31	Mar. 27	May 1	May 2	May 31	June 2	May 31	May 26	Aug. 8
Latest date	May 18	June 13	June 25	June 23	July 12	Sep. 17	Oct. 2	Oct. 10	Sep. 18	Oct. 7
Standard error	2	3	3	2	2	4	5	6	4	3
Number of observations	45	44	40	38	36	47	40	42	39	29
Pinus monticola										
Average date	**Apr. 28**	**May 6**	**May 21**	**June 11**	**June 28**	**Aug. 11**	**Aug. 10**	**Aug. 13**	**Aug. 1**	**Sep. 8**
Earliest date	Mar. 12	Apr. 5	Mar. 27	May 1	May 2 -	June 9	June 1	June 14	June 10	Aug. 1
Latest date	June 6	June 25	June 21	July 3	July 20	Oct. 21	Sep. 21	Sep. 30	Aug. 26	Oct. 2
Standard error	2	2	3	3	3	5	5	3	3	2
Number of observations	54	53	51	38	35	49	49	49	40	37
Pinus ponderosa										
Average date	**Apr. 24**	**May 3**	**May 11**	**June 20**	**June 30**	**July 20**	**Aug. 26**	**July 29**	**Aug. 17**	**Sep. 5**
Earliest date	Mar. 12	Apr. 6	Mar. 27	June 7	June 20	June 4	July 10	June 4	July 7	Aug. 15
Latest date	June 20	May 25	June 25	July 7	July 17	Aug. 21	Oct. 2	Oct. 6	Sep. 16	Sep. 16
Standard error	4	3	6	4	4	4	5	10	6	3
Number of observations	23	23	18	7	7	21	17	19	10	11
Pseudotsuga menziesii										
Average date	**May 2**	**May 17**	**May 23**	**May 31**	**June 14**	**Aug. 10**	**Aug. 12**	**Aug. 19**	**Aug. 6**	**Sep. 13**
Earliest date	Mar. 15	Apr. 5	Mar. 27	Apr. 20	May 1	June 11	May 20	June 16	June 10	Aug. 22
Latest date	June 12	June 29	June 19	July 2	July 15	Oct. 21	Oct. 2	Oct. 7	Sep. 16	Oct. 5
Standard error	2	3	2	4	4	5	5	4	4	2
Number of observations	53	51	50	25	24	49	47	44	32	27
Thuja plicata[2]										
Average date	**Apr. 21**	**May 15**	**May 16**	**May 18**	**June 2**	**Aug. 2**	**Aug. 8**	**Aug. 7**	**Aug. 15**	**Sep. 16**
Earliest date	Apr. 1	Apr. 25	Apr. 20	May 1	May 20	June 20	July 2	Aug. 1	July 16	Aug. 20
Latest date	May 23	June 5	June 1	May 28	June 10	Sep. 30	Sep. 1	Aug. 12	Sep. 10	Oct. 12
Standard error	3	5	9	3	4	17	5	6	4	5
Number of observations	21	8	4	8	6	5	16	2	14	11
Tsuga heterophylla										
Average date	**Apr. 25**	**May 11**	**May 23**	**May 18**	**May 31**	**Aug. 16**	**Aug. 24**	**Aug. 21**	**Aug. 6**	**Sep. 12**
Earliest date	Apr. 4	Apr. 16	Apr. 26	May 3	May 15	June 6	July 10	June 11	July 1	Aug. 25
Latest date	May 15	June 22	June 20	June 1	June 12	Sep. 15	Sep. 20	Sep. 10	Aug. 30	Oct. 7
Standard error	2	3	3	3	3	4	4	4	6	4
Number of observations	30	26	25	10	10	26	28	22	10	9

[1]These were small trees at 2,300 ft (700 m), well below their natural range.

[2]*Thuja plicata* does not have leaf buds; therefore, bud burst and winter buds formed are the start and cessation of leaf growth.

Table 3.--Phenological observations for hardwood trees and shrubs east of the Continental Divide in Montana and Yellowstone National Park, 1928 - 1937.

Species	Leaf buds burst	Leaves full grown	Flowers start	Flowers end	Fruits ripe	Seed fall starts	Leaves start to color to wither	Leaves begin to fall	Leaves fallen withered
Acer glabrum									
Average date	**May 6**	**June 18**	**May 19**	**June 7**	**Aug. 10**	**Sep. 8**	**Aug. 19**	**Sep. 4**	**Sep. 26**
Earliest date	Apr. 20	May 25	May 3	May 15	July 5	Sep. 3	July 20	Aug. 7	Aug. 28
Latest date	May 20	July 10	June 8	June 24	Sep. 6	Sep. 13	Sep. 2	Sep. 19	Oct. 15
Standard error	2	3	3	3	8	3	3	3	3
Number of observations	17	16	15	15	8	3	17	17	17
Alnus incana									
Average date	**May 19**	**June 18**	**Apr. 15**	**May 6**	**Aug. 3**	**June 6**	**Sep. 11**	**Sep. 22**	**Oct. 5**
Earliest date	Apr. 28	June 1	Mar. 9	Mar. 20	May 23	June 2	Aug. 12	Aug. 18	Sep. 20
Latest date	June 10	June 30	May 16	June 15	Oct. 1	June 9	Sep. 21	Oct. 2	Oct. 25
Standard error	3	2	8	9	14	4	4	3	3
Number of observations	17	17	10	10	11	2	10	12	12
Amelanchier alnifolia									
Average date	**May 4**	**June 8**	**May 25**	**June 5**	**July 29**	**Aug. 18**	**Aug. 24**	**Sep. 7**	**Sep. 30**
Earliest date	Apr. 12	May 15	Apr. 15	May 15	July 10	July 11	July 23	Aug. 13	Sep. 5
Latest date	May 29	July 13	June 18	July 3	Aug. 19	Sep. 15	Sep. 25	Oct. 1	Oct. 21
Standard error	3	3	3	3	3	7	3	3	2
Number of observations	27	27	27	26	23	8	25	24	24
Ceanothus velutinus									
Average date	**May 9**	**June 26**	**June 18**	**June 29**	**Aug. 3**	**Aug. 10**			
Earliest date	Apr. 20	May 25	May 12	May 26	July 20	Aug. 10			
Latest date	June 1	July 16	Aug. 18	Aug. 25	Aug. 25	Aug. 10			
Standard error	4	6	12	12	11	0			
Number of observations	10	10	8	7	3	1			
Lonicera involucrata									
Average date	**May 18**	**June 20**	**June 13**	**July 2**	**July 21**			**Aug. 21**	**Sep. 25**
Earliest date	May 6	June 14	May 30	June 20	July 11			Aug. 16	Sep. 20
Latest date	May 29	June 26	June 26	July 14	July 30			Sep. 1	Sep. 27
Standard error	7	6	5	5	3			5	2
Number of observations	3	2	6	6	6			3	3
Lonicera utahensis									
Average date	**Apr. 26**	**May 31**	**May 19**	**June 8**	**June 29**		**Aug. 21**	**Sep. 6**	**Sep. 28**
Earliest date	Apr. 5	May 15	Apr. 30	May 18	May 6		July 15	Aug. 21	Sep. 15
Latest date	May 6	July 1	June 2	June 20	July 21		Sep. 19	Sep. 26	Oct. 10
Standard error	3	5	3	3	8		6	5	3
Number of observations	12	12	12	12	9		9	9	9
Pachistima myrsinites									
Average date	**May 10**	**June 17**	**June 27**	**July 18**	**Aug. 7**	**Aug. 29**	**Sep. 2**	**Sep. 18**	**Oct. 18**
Earliest date	Apr. 30	June 4	June 20	July 11	Aug. 1	Aug. 8	Sep. 1	Sep. 15	Oct. 15
Latest date	May 30	June 29	July 3	July 26	Aug. 17	Aug. 10	Sep. 3	Sep. 20	Oct. 22
Standard error	4	3	2	2	2	1	0	1	2
Number of observations	8	8	8	8	8	4	4	4	4
Physocarpus malvaceus									
Average date	**May 3**	**June 18**	**June 13**	**July 6**	**Aug. 4**	**Aug. 17**	**Aug. 9**	**Aug. 24**	**Sep. 25**
Earliest date	Apr. 6	May 17	May 22	June 18	June 16	July 26	July 1	July 23	Aug. 28
Latest date	May 20	July 20	June 30	July 21	Sep. 9	Sep. 18	Sep. 19	Sep. 26	Oct. 26
Standard error	2	3	2	2	4	16	3	3	3
Number of observations	23	23	24	24	24	3	24	24	24
Populus tremuloides									
Average date	**May 16**	**June 12**	**May 1**	**May 25**	**June 10**	**June 1**	**Sep. 1**	**Sep. 14**	**Oct. 3**
Earliest date	Apr. 20	May 20	Mar. 15	Apr. 10	May 16	May 21	July 20	July 23	Aug. 7
Latest date	June 5	July 10	June 2	July 16	July 26	June 14	Sep. 30	Oct. 5	Oct. 30
Standard error	1	2	3	5	4	4	2	2	2
Number of observations	48	46	35	29	27	5	50	49	49
Populus trichocarpa									
Average date	**May 14**	**June 20**	**May 11**	**June 5**	**July 2**		**Sep. 10**	**Sep. 23**	**Oct. 14**
Earliest date	Apr. 28	June 10	Apr. 25	Apr. 10	May 17		July 23	Aug. 10	Oct. 5
Latest date	May 29	July 12	June 4	July 12	July 19		Sep. 19	Oct. 3	Oct. 22
Standard error	3	2	3	10	7		4	4	2
Number of observations	14	14	10	10	10		14	14	14

Table 3. con.

Table 3. con.

Species	Leaf buds burst	Leaves full grown	Flowers start	Flowers end	Fruits ripe	Seed fall starts	Leaves start to color to wither	Leaves begin to fall	Leaves fallen withered
Prunus virginiana									
Average date	**May 2**	**June 11**	**June 4**	**June 17**	**Aug. 22**	**Sep. 12**	**Aug. 31**	**Sep. 10**	**Sep. 30**
Earliest date	Apr. 10	May 5	May 14	May 25	Aug. 7	Aug. 23	July 23	Aug. 7	Sep. 10
Latest date	May 22	July 3	July 6	July 15	Sep. 15	Sep. 29	Sep. 25	Oct. 14	Nov. 26
Standard error	2	3	3	3	3	8	2	3	3
Number of observations	27	26	26	26	17	4	27	26	26
Sambucus cerulea									
Average date	**June 1**	**June 28**	**June 27**	**July 16**	**Aug. 22**				**Sep. 20**
Earliest date	May 16	June 22	May 30	June 22	Aug. 13				Sep. 20
Latest date	June 20	July 4	July 20	Aug. 10	Sep. 3				Sep. 20
Standard error	10	6	8	9	5				0
Number of observations	3	2	5	5	4				1
Shepherdia canadensis									
Average date	**May 17**	**June 25**	**May 14**	**May 29**	**July 28**	**Aug. 21**	**Aug. 31**	**Sep. 10**	**Oct. 1**
Earliest date	Apr. 3	May 20	Apr. 10	Apr. 30	July 1	Aug. 5	July 20	Aug. 7	Aug. 31
Latest date	June 28	Aug. 1	June 20	July 20	Aug. 18	Sep. 11	Sep. 20	Oct. 1	Oct. 15
Standard error	3	4	3	3	2	6	3	2	2
Number of observations	35	34	33	33	26	6	29	29	29
Spiraea betulifolia									
Average date	**May 8**	**June 22**	**July 6**	**July 24**	**Aug. 20**	**Aug. 30**	**Aug. 20**	**Sep. 2**	**Sep. 24**
Earliest date	Apr. 15	May 20	May 25	June 11	June 28	Aug. 14	July 1	July 23	Sep. 9
Latest date	May 29	Aug. 15	Aug. 5	Aug. 22	Sep. 11	Sep. 10	Sep. 10	Sep. 25	Oct. 12
Standard error	2	4	5	4	5	4	3	3	2
Number of observations	28	27	23	24	17	6	25	24	21
Symphoricarpos albus									
Average date	**May 6**	**June 14**	**July 4**	**July 22**	**Sep. 2**	**Sep. 14**	**Aug. 28**	**Sep. 9**	**Sep. 30**
Earliest date	Apr. 10	May 17	June 4	June 10	Aug. 7	Aug. 16	July 20	July 23	Aug. 28
Latest date	June 7	July 10	Aug. 11	Aug. 21	Oct. 9	Oct. 14	Sep. 25	Oct. 15	Oct. 30
Standard error	2	2	2	3	2	6	2	2	2
Number of observations	53	53	50	46	43	8	50	50	45
Vaccinium scoparium									
Average date	**May 17**	**June 12**	**June 8**	**June 26**	**Aug. 7**	**Aug. 13**	**Aug. 30**	**Sep. 10**	**Sep. 28**
Earliest date	Apr. 30	May 21	May 1	May 10	July 22	Aug. 3	Aug. 17	Aug. 22	Sep. 2
Latest date	June 20	July 25	July 4	July 21	Aug. 15	Aug. 20	Sep. 12	Sep. 30	Oct. 24
Standard error	3	5	5	5	2	2	2	2	6
Number of observations	16	15	17	17	14	6	15	14	10

[1]*Ceanothus velutinus* has no bud scales. "Shoots Start" would be a better term than "Leaf Buds Burst" for this species.

Table 4.--Phenological observations for hardwood trees and shrubs in Northern Idaho and west of the Continental Divide in Montana, 1928 - 1937.

Species	Leaf buds burst	Leaves full grown	Flowers start	Flowers end	Fruits ripe	Seed fall starts	Leaves start to color to wither	Leaves begin to fall	Leaves fallen withered
Acer glabrum									
Average date	**May 3**	**June 6**	**May 17**	**May 29**	**Aug. 6**	**Sep. 9**	**Aug. 28**	**Sep. 15**	**Oct. 12**
Earliest date	Apr. 5	May 8	Apr. 26	May 5	July 10	Sep. 9	June 12	Aug. 18	Sep. 20
Latest date	May 20	July 22	June 4	June 18	Aug. 30	Sep. 9	Sep. 22	Oct. 4	Nov. 15
Standard error	3	4	3	4	8	0	4	3	3
Number of observations	23	23	15	14	6	1	24	22	19
Alnus incana									
Average date	**May 7**	**June 8**	**May 15**	**May 30**	**Aug. 24**	**Sep. 10**	**Sep. 5**	**Sep. 20**	**Oct. 14**
Earliest date	Apr. 10	May 1	Mar. 20	Apr. 15	May 20	May 25	July 25	Aug. 7	Sep. 5
Latest date	May 28	July 28	June 28	July 10	Oct. 20	Dec. 16	Oct. 15	Oct. 21	Nov. 1
Standard error	2	3	4	3	5	16	3	3	2
Number of observations	42	44	37	37	30	10	43	43	37
Amelanchier alnifolia									
Average date	**May 3**	**June 1**	**May 21**	**June 5**	**July 30**	**Aug. 19**	**Aug. 28**	**Sep. 14**	**Oct. 7**
Earliest date	Apr. 5	Apr. 25	Apr. 18	Apr. 24	June 25	July 10	June 20	July 15	Sep. 2
Latest date	May 28	July 15	June 16	July 1	Sep. 10	Sep. 30	Oct. 2	Nov. 11	Nov. 11
Standard error	2	3	2	2	2	6	3	3	2
Number of observations	56	58	50	54	52	19	58	55	49
Ceanothus velutinus									
Average date	**May 8**	**June 7**	**June 6**	**July 12**	**July 22**	**Aug. 2**	**Aug. 14**		
Earliest date	Apr. 15	May 21	May 18	June 5	June 21	Aug. 1	July 2		
Latest date	June 6	July 2	June 20	Aug. 18	Aug. 5	Aug. 5	Sep. 26		
Standard error	5	4	3	9	6	1	43		
Number of observations	8	11	10	9	7	3	2		
Lonicera utahensis									
Average date	**Apr. 29**	**May 28**	**May 11**	**June 3**	**July 3**	**July 8**	**Aug. 14**	**Sep. 2**	**Sep. 29**
Earliest date	Apr. 1	May 1	Apr. 24	May 5	May 18	June 12	June 7	July 2	Aug. 2
Latest date	May 28	June 23	June 22	July 20	Aug. 20	Aug. 11	Sep. 21	Oct. 9	Oct. 27
Standard error	3	3	3	4	5	7	5	5	4
Number of observations	21	22	21	23	23	9	23	24	23
Pachistima myrsinites									
Average date	**May 3**	**June 3**	**May 15**	**June 7**	**July 16**	**July 27**	**Aug. 30**	**Sep. 17**	**Oct. 6**
Earliest date	Apr. 12	May 1	Apr. 17	Apr. 26	May 5	June 4	June 7	Sep. 1	Sep. 15
Latest date	June 1	July 2	June 24	July 26	Sep. 1	Sep. 15	Oct. 16	Oct. 6	Oct. 21
Standard error	2	3	2	3	4	11	7	3	3
Number of observations	39	41	46	44	40	13	16	14	14
Physocarpus malvaceus									
Average date	**May 7**	**May 21**	**June 10**	**July 4**	**Aug. 18**		**Aug. 24**	**Sep. 26**	**Oct. 18**
Earliest date	Apr. 26	May 7	May 15	June 16	July 22		Aug. 15	Sep. 8	Oct. 18
Latest date	May 20	June 1	July 5	July 25	Sep. 25		Sep. 11	Oct. 12	Oct. 18
Standard error	4	4	8	6	12		4	10	0
Number of observations	5	5	6	6	5		6	3	1
Populus tremuloides									
Average date	**May 9**	**June 3**	**May 30**	**June 20**	**July 9**	**Aug. 6**	**Sep. 10**	**Sep. 25**	**Oct. 15**
Earliest date	Apr. 15	May 10	Apr. 1	May 12	June 25	July 28	July 28	Aug. 18	Sep. 18
Latest date	May 29	July 13	June 30	July 12	July 25	Aug. 15	Oct. 1	Oct. 10	Nov. 10
Standard error	2	2	6	4	3	9	3	2	2
Number of observations	34	36	15	15	12	2	35	29	27
Populus trichocarpa									
Average date	**Apr. 30**	**May 30**	**May 8**	**June 3**	**June 13**	**June 26**	**Sep. 14**	**Sep. 25**	**Oct. 14**
Earliest date	Apr. 20	May 1	Apr. 6	Apr. 20	June 2	June 19	Aug. 8	Sep. 4	Oct. 1
Latest date	May 14	July 13	June 26	July 19	June 25	July 2	Sep. 30	Oct. 3	Oct. 31
Standard error	2	5	9	13	4	6	5	3	3
Number of observations	13	13	8	7	5	2	12	10	8
Prunus virginiana									
Average date	**Apr. 29**	**May 17**	**May 19**	**June 11**	**Aug. 14**	**Sep. 19**	**Sep. 15**	**Sep. 28**	**Oct. 14**
Earliest date	Apr. 15	Apr. 16	Apr. 1	May 15	June 25	Aug. 18	Aug. 20	Sep. 15	Oct. 2
Latest date	May 8	June 10	June 16	July 2	Sep. 5	Oct. 21	Oct. 25	Oct. 10	Oct. 26
Standard error	2	4	4	3	5	13	5	2	2
Number of observations	14	14	15	15	14	5	15	16	14

Table 4. con.

Table 4. con.

Species	Leaf buds burst	Leaves full grown	Flowers start	Flowers end	Fruits ripe	Seed fall starts	Leaves start to color to wither	Leaves begin to fall	Leaves fallen withered
Rubus parviflorus									
Average date	**May 12**	**June 16**	**June 19**	**July 7**	**Aug. 5**	**Aug. 14**	**Aug. 26**	**Sep. 14**	**Oct. 5**
Earliest date	Apr. 5	May 12	May 9	June 16	June 30	July 15	Aug. 1	Aug. 21	Aug. 28
Latest date	June 3	July 20	July 13	Aug. 11	Sep. 3	Aug. 27	Sep. 30	Oct. 1	Oct. 23
Standard error	2	3	2	2	2	3	2	2	2
Number of observations	39	40	39	41	40	15	42	38	34
Sambucus cerulea									
Average date	**Apr. 30**	**June 4**	**June 2**	**June 28**	**Aug. 21**	**Sep. 18**	**Aug. 31**	**Sep. 19**	**Oct. 12**
Earliest date	Apr. 12	May 21	May 16	June 5	Aug. 1	Aug. 20	Aug. 10	Sep. 15	Oct. 5
Latest date	May 15	June 21	June 23	July 15	Sep. 2	Oct. 2	Sep. 26	Oct. 5	Oct. 16
Standard error	7	5	7	8	7	10	8	4	3
Number of observations	4	5	5	5	4	4	5	5	4
Shepherdia canadensis									
Average date	**May 19**	**June 14**	**May 15**	**June 3**	**July 9**		**Aug. 13**	**Sep. 11**	**Oct. 4**
Earliest date	May 8	June 2	May 1	May 26	July 7		July 26	Aug. 7	Sep. 22
Latest date	June 3	June 30	May 28	June 11	July 12		Sep. 3	Oct. 5	Oct. 13
Standard error	6	4	7	5	1		6	8	3
Number of observations	5	6	4	3	3		6	6	6
Spiraea betulifolia									
Average date	**May 6**	**June 7**	**July 5**	**July 26**	**Aug. 20**	**Aug. 25**	**Aug. 26**	**Sep. 15**	**Oct. 5**
Earliest date	Mar. 20	May 5	June 8	June 25	July 15	July 31	Aug. 1	Aug. 24	Sep. 3
Latest date	May 28	July 5	July 26	Aug. 16	Sep. 26	Sep. 9	Oct. 1	Oct. 6	Oct. 31
Standard error	3	3	2	2	3	6	3	2	3
Number of observations	31	31	26	27	25	6	29	26	23
Symphoricarpos albus									
Average date	**May 1**	**May 29**	**June 18**	**July 19**	**Aug. 25**	**Sep. 20**	**Sep. 2**	**Sep. 14**	**Oct. 10**
Earliest date	Mar. 20	Apr. 28	May 5	May 15	July 29	Aug. 16	July 2	July 21	Aug. 28
Latest date	May 28	July 15	July 31	Sep. 5	Sep. 28	Oct. 31	Oct. 25	Oct. 24	Nov. 15
Standard error	2	3	3	3	2	5	3	3	3
Number of observations	53	55	54	54	53	18	55	50	43
Vaccinium scoparium									
Average date	**May 3**	**May 26**	**May 17**	**June 2**	**July 21**	**Aug. 14**	**Aug. 22**	**Sep. 12**	**Oct. 4**
Earliest date	Mar. 27	Apr. 25	Apr. 15	May 15	July 5	Aug. 10	July 3	Aug. 13	Sep. 5
Latest date	May 28	June 30	June 12	July 2	Aug. 29	Aug. 23	Sep. 10	Oct. 5	Oct. 16
Standard error	4	4	4	3	3	2	4	3	3
Number of observations	18	19	17	18	18	5	20	17	13

[1]*Ceanothus velutinus* has no bud scales. "Shoots Start" would be a better term than "Leaf Buds Burst" for this species.

Table 5.--Phenological observations for herbs (including low-woody plants) east of the Continental Divide in Montana and in Yellowstone National Park, 1928 - 1937.

Species	First appearance	Leaf buds burst	Leaves full grown	Flowers start	Flowers end	Fruits ripe	Seed fall starts	Leaves start to color to wither	Leaves begin to fall	Leaves fallen withered	First frost injury
Achillea millefolium											
Average date	**Apr. 30**		**June 21**	**June 23**	**Aug. 2**	**Aug. 13**	**Aug. 19**	**Aug. 16**		**Sep. 11**	**Aug. 31**
Earliest date	Mar. 30		May 1	May 30	July 1	July 3	July 21	July 12		July 19	Aug. 16
Latest date	June 1		July 24	Aug. 2	Sep. 21	Sep. 24	Oct. 11	Sep. 25		Oct. 15	Sep. 21
Standard error	2		3	2	3	3	4	3		3	3
Number of observations	45		47	43	40	41	25	41		45	20
Agropyron spicatum											
Average date	**Apr. 14**		**June 20**	**June 15**	**July 9**	**July 29**	**Aug. 5**	**Aug. 14**		**Sep. 8**	**Sep. 5**
Earliest date	Mar. 25		May 25	May 15	June 10	June 15	June 20	June 23		Aug. 1	Aug. 20
Latest date	May 16		July 27	July 12	July 23	Sep. 12	Oct. 1	Oct. 1		Oct. 15	Sep. 16
Standard error	3		5	4	6	6	12	7		12	7
Number of observations	14		14	14	7	14	7	12		12	4
Antennaria[1]											
Average date	**May 8**		**July 2**	**June 21**	**July 23**	**July 31**	**Aug. 4**	**Aug. 22**		**Oct. 5**	**Sep. 3**
Earliest date	Apr. 5		May 25	May 20	June 5	June 10	June 12	July 1		Aug. 13	Sep. 1
Latest date	June 1		Aug. 2	July 20	Aug. 10	Aug. 21	Aug. 20	Sep. 16		Nov. 1	Sep. 7
Standard error	3		4	3	6	5	5	6		9	2
Number of observations	28		28	26	13	24	14	12		10	4
Arctostaphylos uva-ursi											
Average date		**June 6**	**Aug. 2**	**May 30**	**June 11**	**Aug. 23**	**Oct. 16**				
Earliest date		May 27	July 21	May 15	May 31	May 25	Oct. 16				
Latest date		June 22	Aug. 15	June 20	June 30	Sep. 25	Oct. 16				
Standard error		3	2	4	4	16	0				
Number of observations		8	8	8	8	7	2				
Arnica cordifolia											
Average date	**May 13**		**June 14**	**June 18**	**July 12**	**July 23**	**July 26**	**July 25**		**Aug. 19**	**Aug. 24**
Earliest date	Apr. 15		May 2	May 6	May 20	May 25	June 1	June 10		July 6	Aug. 1
Latest date	June 20		July 13	July 15	Aug. 14	Aug. 22	Aug. 22	Sep. 10		Oct. 11	Sep. 15
Standard error	2		2	2	2	2	3	2		3	4
Number of observations	59		61	59	55	55	29	57		56	15
Balsamorhiza sagittata											
Average date	**Apr. 26**		**June 4**	**May 18**	**June 16**	**July 7**	**July 15**	**July 17**		**Aug. 9**	**Sep. 3**
Earliest date	Apr. 3		May 15	Apr. 27	May 15	June 13	June 19	June 20		July 25	Sep. 1
Latest date	May 13		July 2	June 18	July 8	Aug. 2	Aug. 7	Aug. 13		Sep. 16	Sep. 4
Standard error	3		3	3	4	4	5	4		12	2
Number of observations	16		16	18	18	15	10	17		17	2
Berberis repens									[2]		
Average date		**May 6**	**June 12**	**May 28**	**June 22**	**Aug. 11**	**Aug. 9**	**Sep. 8**	**Sep. 20**	**Oct. 15**	
Earliest date		Apr. 20	May 15	Apr. 28	May 15	June 23	July 16	Aug. 25	Sep. 17	Oct. 10	
Latest date		May 30	June 28	July 4	Aug. 2	Sep. 15	Sep. 1	Sep. 15	Sep. 24	Aug. 18	
Standard error		2	2	3	4	4	6	4	2	2	
Number of observations		25	24	32	31	22	7	5	4	4	
Calamagrostis rubescens											
Average date	**May 6**		**June 22**	**July 2**	**July 22**	**Aug. 6**	**Aug. 20**	**Aug. 21**		**Oct. 5**	**Sep. 3**
Earliest date	Apr. 6		May 1	May 10	June 24	June 27	July 29	July 4		Aug. 28	Aug. 15
Latest date	May 31		July 12	Aug. 10	Aug. 18	Sep. 25	Sep. 25	Sep. 25		Oct. 30	Sep. 30
Standard error	2		3	5	3	4	6	3		3	3
Number of observations	32		29	23	11	21	12	39		25	17
Campanula rotundifolia											
Average date			**June 20**	**June 29**	**July 31**	**Aug. 20**	**Aug. 19**	**Aug. 13**		**Sep. 8**	
Earliest date			June 14	June 20	July 18	Aug. 12	Aug. 16	Aug. 2		Aug. 30	
Latest date			June 26	July 20	Aug. 13	Aug. 30	Aug. 22	Aug. 22		Sep. 20	
Standard error			6	4	5	3	2	6		5	
Number of observations			2	7	4	5	4	3		4	
Clematis hirsutissima											
Average date	**May 3**		**June 9**	**May 16**	**June 7**	**July 10**	**July 14**	**July 21**		**Aug. 13**	**Aug. 20**
Earliest date	Apr. 11		May 6	Apr. 21	May 25	June 28	June 28	July 1		July 15	Aug. 20
Latest date	May 13		June 29	June 10	July 1	July 21	July 25	Aug. 15		Sep. 15	Aug. 20
Standard error	3		5	4	3	3	4	5		8	0
Number of observations	9		9	10	10	9	6	8		13	2

Table 5. con.

Table 5. con.

Species	First appearance	Leaf buds burst	Leaves full grown	Flowers start	Flowers end	Fruits ripe	Seed fall starts	Leaves start to color to wither	Leaves begin to fall	Leaves fallen withered	First frost injury
Epilobium angustifolium											
Average date	**May 21**		**July 11**	**July 16**	**Aug. 9**	**Aug. 19**	**Aug. 20**	**Aug. 25**		**Sep. 9**	**Aug. 29**
Earliest date	May 1		May 16	June 14	July 15	Aug. 3	Aug. 3	July 15		July 20	Aug. 5
Latest date	June 14		Aug. 2	Aug. 10	Aug. 20	Sep. 6	Sep. 3	Sep. 19		Sep. 30	Sep. 10
Standard error	2		3	3	2	2	3	2		3	2
Number of observations	33		31	29	24	21	12	31		29	15
Erythronium grandiflorum											
Average date	**Apr. 30**		**May 29**	**May 12**	**May 31**	**July 5**	**July 16**	**June 24**		**July 15**	
Earliest date	Mar. 25		Apr. 21	Apr. 12	Apr. 28	May 18	May 23	May 10		June 10	
Latest date	June 7		July 6	June 10	June 25	Aug. 14	Aug. 16	Aug. 14		Sep. 3	
Standard error	2		3	2	2	4	5	3		3	
Number of observations	41		41	42	42	37	20	39		40	
Festuca idahoensis											
Average date	**Apr. 24**		**June 23**	**June 30**	**July 16**	**Aug. 4**	**Aug. 12**	**Aug. 11**		**Sep. 16**	**Aug. 27**
Earliest date	Mar. 15		May 1	May 12	June 10	July 2	July 17	June 25		Aug. 1	Aug. 16
Latest date	May 25		July 22	Aug. 11	Aug. 3	Sep. 2	Sep. 6	Oct. 1		Oct. 20	Sep. 16
Standard error	3		3	4	5	3	4	3		4	3
Number of observations	36		36	27	12	26	14	36		31	11
Fragaria vesca											
Average date	**May 7**		**June 8**	**June 10**	**July 5**	**Aug. 3**	**Aug. 12**	**Aug. 29**		**Sep. 24**	
Earliest date	Apr. 20		May 10	May 10	June 29	July 21	Aug. 1	Aug. 5		Sep. 1	
Latest date	May 17		July 6	June 24	July 16	Aug. 15	Aug. 25	Sep. 16		Oct. 16	
Standard error	3		6	6	2	7	7	7		23	
Number of observations	9		9	9	9	3	3	3		2	
Linnaea borealis											
Average date	**May 27**	**May 21**	**July 8**	**July 8**	**Aug. 4**	**Aug. 13**	**Aug. 18**	**Sep. 9**	**Sep. 17**	**Sep. 26**	
Earliest date	May 5	May 6	June 7	May 21	July 20	July 15	Aug. 7	Sep. 1	Sep. 17	Sep. 26	
Latest date	May 29	June 10	Aug. 10	Aug. 2	Aug. 16	Sep. 1	Sep. 3	Sep. 16	Sep. 17	Sep. 26	
Standard error	7	4	5	5	3	6	4	4	0	0	
Number of observations	3	8	13	14	13	7	6	4	1	1	
Myosotis alpestris											
Average date	**June 1**		**June 10**	**June 6**	**July 5**	**July 13**	**July 15**				
Earliest date	June 1		June 10	May 16	June 28	July 8	July 15				
Latest date	June 1		June 10	June 20	July 10	July 15	July 15				
Standard error	0		0	5	3	2	0				
Number of observations	1		1	6	4	4	1				

[1]The species was not identified at that time, but it was most likely *Antennaria racemosa.*

[2]*Berberis repens* leaves fall during the period of time that the current year's leaves develop. The dates shown here are likely the most apparent start of leaf fall.

Table 6.--Phenological observations for herbs (including low-woody plants) in northern Idaho and west of the Continental Divide in Montana, 1928 - 1937.

Species	First appearance	Leaf buds burst	Leaves full grown	Flowers start	Flowers end	Fruits ripe	Seed fall starts	Leaves start to color to wither	Leaves begin to fall	Leaves fallen withered	First frost injury
Achillea millefolium											
Average date	**Apr. 19**		**May 29**	**June 12**	**Aug. 6**	**Aug. 19**	**Aug. 27**	**Aug. 31**		**Sep. 23**	**Sep. 14**
Earliest date	Mar. 15		Apr. 23	May 12	July 14	July 31	July 31	Aug. 5		Sep. 4	Sep. 1
Latest date	May 12		July 26	July 29	Aug. 28	Sep. 15	Oct. 2	Oct. 5		Oct. 12	Oct. 5
Standard error	3		4	3	2	2	3	3		2	3
Number of observations	32		34	33	30	30	21	31		23	10
Agropyron spicatum											
Average date	**Apr. 13**		**May 19**	**May 26**	**June 12**	**July 11**	**July 24**	**Aug. 23**	**Jan. 27**	**Oct. 1**	**Sep. 7**
Earliest date	Apr. 1		May 1	May 15	June 1	July 1	July 15	Aug. 1	Jan. 27	Oct. 1	Sep. 1
Latest date	Apr. 25		June 1	June 2	June 26	Aug. 1	Aug. 10	Sep. 6	Jan. 27	Oct. 1	Sep. 20
Standard error	3		3	2	3	2	3	4	0	0	4
Number of observations	11		11	11	6	11	7	11	1	1	5
Arnica cordifolia											
Average date	**Apr. 21**		**May 12**	**May 11**	**June 7**	**June 15**	**June 2**	**July 5**	**June 1**	**July 17**	**July 5**
Earliest date	Mar. 12		Mar. 28	Apr. 5	Apr. 24	May 10	May 10	May 16	June 1	June 4	June 10
Latest date	May 28		June 25	June 9	Oct. 1	Oct. 1	June 26	Oct. 15	June 1	Aug. 20	July 30
Standard error	7		7	6	13	12	8	11	0	7	25
Number of observations	11		13	11	11	11	6	13	1	12	2
Balsamorhiza sagittata											
Average date	**Apr. 20**		**May 16**	**May 10**	**June 12**	**July 14**	**July 20**	**Aug. 17**		**Sep. 20**	**Sep. 1**
Earliest date	Apr. 8		May 2	May 2	June 1	June 15	July 10	Aug. 1		Aug. 16	Aug. 5
Latest date	May 2		June 1	May 16	June 20	July 16	Aug. 1	Aug. 25		Oct. 5	Sep. 21
Standard error	2		3	1	2	3	4	3		5	8
Number of observations	10		10	10	10	10	7	10		10	7
Berberis repens											
Average date		**May 2**	**May 24**	**May 6**	**May 29**	**Aug. 2**	**Aug. 12**	**Sep. 27**			
Earliest date		Mar. 20	Apr. 11	Mar. 20	Apr. 15	June 21	July 16	Sep. 24			
Latest date		May 28	July 1	May 28	June 16	Sep. 1	Sep. 14	Oct. 1			
Standard error		4	4	3	3	3	6	2			
Number of observations		23	28	29	30	30	8	3			
Calamagrostis rubescens											
Average date	**Apr. 19**		**May 30**	**May 30**	**July 2**	**July 14**	**July 28**	**Aug. 28**	**Aug. 18**	**Sep. 26**	**Sep. 13**
Earliest date	Apr. 1		May 5	May 5	June 1	July 1	July 18	July 15	Aug. 18	Aug. 5	Sep. 3
Latest date	May 6		July 15	July 4	Sep. 30	Aug. 1	Aug. 10	Oct. 6	Aug. 18	Oct. 21	Sep. 25
Standard error	4		5	5	12	2	2	9	0	10	3
Number of observations	9		18	18	9	17	11	14	1	8	6
Cirsium arvense											
Average date	**Apr. 25**		**May 20**	**June 16**	**July 17**	**July 31**	**Aug. 8**	**Aug. 30**		**Sep. 14**	**Sep. 1**
Earliest date	Apr. 10		May 1	May 1	July 5	July 20	July 24	Aug. 2		Sep. 1	Sep. 1
Latest date	May 10		June 11	July 9	July 29	Aug. 2	Aug. 18	Sep. 23		Sep. 24	Sep. 1
Standard error	5		6	8	4	5	5	6		5	0
Number of observations	6		6	7	5	5	4	7		4	1
Clintonia uniflora											
Average date	**May 10**		**June 21**	**June 16**	**July 1**	**Aug. 11**	**Aug. 19**	**Aug. 23**		**Oct. 1**	**Sep. 10**
Earliest date	Apr. 25		June 1	May 30	June 15	July 22	Aug. 1	Aug. 1		Sep. 14	Aug. 23
Latest date	May 20		July 2	July 1	July 25	Aug. 26	Aug. 31	Sep. 1		Oct. 7	Sep. 24
Standard error	2		3	3	3	3	4	2		2	4
Number of observations	13		13	15	15	14	7	14		13	8
Epilobium angustifolium											
Average date	**May 1**		**June 12**	**July 3**	**Aug. 8**	**Aug. 17**	**Aug. 20**	**Aug. 28**		**Sep. 23**	**Sep. 6**
Earliest date	Mar. 25		May 3	Apr. 30	July 2	July 20	July 20	July 15		Aug. 28	Aug. 16
Latest date	June 4		July 21	Aug. 2	Sep. 4	Sep. 6	Sep. 11	Sep. 21		Oct. 16	Oct. 5
Standard error	3		4	3	2	2	3	2		2	4
Number of observations	31		34	35	35	34	23	33		30	14
Erythronium grandiflorum											
Average date	**Apr. 13**		**Apr. 24**	**Apr. 23**	**May 14**	**June 5**	**May 22**	**June 9**		**June 24**	
Earliest date	Mar. 5		Mar. 20	Mar. 12	Apr. 8	Apr. 22	Apr. 28	May 10		May 15	
Latest date	May 5		May 13	May 15	June 1	June 29	June 15	Aug. 1		Aug. 20	
Standard error	6		4	5	4	8	10	8		8	
Number of observations	10		13	14	14	9	4	13		12	
Linnaea borealis											
Average date	**May 12**		**June 18**	**June 28**	**Aug. 1**	**Aug. 9**	**Aug. 17**	**Sep. 7**		**Sep. 29**	**Sep. 19**
Earliest date	May 4		May 31	June 17	July 22	July 18	July 26	Aug. 15		Sep. 16	Sep. 2
Latest date	May 17		July 1	July 14	Aug. 11	Aug. 25	Sep. 2	Sep. 24		Sep. 4	Oct. 3
Standard error	4		6	6	3	6	6	7		4	9
Number of observations	3		5	5	6	6	6	5		4	3
Lonicera ciliosa											
Average date		**Apr. 18**	**May 15**	**May 16**	**June 20**	**July 12**	**Aug. 19**	**Sep. 3**	**Sep. 28**	**Oct. 11**	
Earliest date		Mar. 20	May 2	Apr. 8	May 22	June 7	July 26	Aug. 16	Sep. 18	Oct. 3	
Latest date		May 10	May 25	June 12	July 18	Sep. 9	Sep. 12	Sep. 16	Oct. 11	Oct. 16	
Standard error		5	2	7	6	10	24	4	4	4	
Number of observations		10	10	10	10	8	2	8	5	3	
Trillium ovatum											
Average date	**Apr. 26**		**May 14**	**May 4**	**May 28**	**June 30**	**July 7**	**July 23**	**Sep. 25**	**Aug. 15**	**Aug. 23**
Earliest date	Mar. 27		Apr. 16	Apr. 10	Apr. 27	May 4	May 8	May 27	Sep. 25	June 12	July 30
Latest date	May 23		June 24	June 1	June 25	Aug. 13	Aug. 26	Sep. 15	Sep. 25	Oct. 5	Sep. 20
Standard error	2		3	2	2	3	5	4	0	4	6
Number of observations	38		45	44	49	46	26	46	1	44	11

SUMMARY

Our object has been to present a useful reference for both research and management activities. The user should recognize that these data encompass variation due to location and season, as well as experimental error. As an example, in some cases latest "seed fall" date is earlier than latest "fruit ripe" date. The user should always examine the entire spectrum of data for each species. The user should also recognize that this is an unusually broad data base encompassing many species over a broad geographic range for a long period of time. Although these data were collected 40 to 50 years ago, we feel the results are as valid and useful now as they were envisioned at the outset of the study.

APPENDIX

Following are the original definitions of the phenological events provided the field observers as referenced in tables 1-6 of this paper.

Gymnosperms

Phenological event	Original definitions provided the observers in this study
Bark slips	The time when cambial activity commences so that it becomes slimy and the bark readily separates from the wood as it does not in the dormant winter period. This can best be tested by a jackknife or hand ax, but do not injure by repeated barking the trees, which must be observed for several years.
Shoots start	The time when the terminal bud bursts or commences elongation. Care should be taken to observe the average of a group of small trees.
Buds burst	The date when the leaves have broken through the bud scales and show green but have not yet straightened out. Avoid confusion with flower buds.
Pollen starts	The time when a reasonable amount of pollen can be noticed on shaking the branches; in damp weather a very close observation would be necessary to determine when the pollen is ripe.
Pollen ends	The time when the coniferous flowers become so old that they no longer liberate pollen.
Shoots end	More difficult to obtain than the commencement of height growth, and actual measurements recorded in the notebook toward the end of spring and early summer will help fix the date when elongation of the leader stops. Measure length of stem, without needles.
Bark sticks	The time when the cambium has ceased to be slimy and the bark does not readily separate from the wood in testing with knife or ax. In some species this occurs during the formation of summer wood, and in others it may be indicative of the cessation of diameter growth.
Winter buds formed	The time when at the tips of most of the twigs completely formed characteristic winter buds are in evidence.
Cones full size	The time when the cones reach their mature length. Occasional comparison with old cones will help the observer.
Cones open	The date when sound cones begin to spread their scales and release the seed, usually after they have turned brown in color. Insect-infested cones should not be considered, for in some cases, they open abnormally early and in others remain closed.

Angiosperms

Phenological event	Original definitions provided the observers in this study
First appearance	The date the herbaceous plant first breaks through the ground, or, in the case of perennials, when the new shoots from the root collar begin to make visible growth.
Leaf buds burst	The date when leaves have broken through the bud scales and show green but have not yet straightened out. Avoid confusion with flower buds.
Leaves full grown	The date when the average leaves of the plant observed reach mature size. This requires the observer to know the size of the fully grown leaf. Occasional measurements recorded in the notebook would not be amiss, or comparison with last year's fallen leaves.
Flowers start	The date when the first flowers open and expose their stamens and pistils, or, in the case of those which barely open, the time when the anthers shed their pollen.
Flowers end	This date marks the end of the flowering period, that is, the time when the majority of the flowers have faded or fallen.
Fruits ripe	A useful index of the maturity of the seeds of plants in which there is a distinct difference between the green and the mature stage of the fruits.
Seed fall starts	The date when the seeds begin to fall in considerable quantity naturally from the plant.
Leaves start to color and to wither	The time when general coloring of the foliage commences; care needs to be exercised to discriminate between injured or abnormal leaves and the normal autumnal coloring. The time when leaves begin to dry or turn brown or curl up as a sign of the cessation of life.
Leaves begin to fall	The date when a considerable fall of leaves is noted, care being taken not to confuse autumn leaf fall with leaf fall due to shedding of leaves on inside of crown or due to injury.
Leaves fallen withered	The time when autumnal leaf fall has reached the point when the trees and shrubs are pratically bare of leaves.
First frost injury	The time when herbaceous plants are first colored or withered by frosts.

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Schmidt, Wyman C., and James E. Lotan.
1980. Phenology of common forest flora of the Northern Rockies--1928 to 1937. USDA For. Serv. Res. Pap. INT-259, 20p. Intermt. For. and Range Exp. Stn., Ogden, Utah 84401.

This paper presents 10 years (1928 to 1937) of phenological observations in the Northern Rockies. Phenological events are summarized by earliest, latest, and average dates of occurrence. Included are records for 50 species--13 conifers, 22 hardwood trees and shrubs, and 15 herbaceous plants. Phenological data were collected from eastern Montana to northern Idaho on many National Forests as well as Yellowstone and Glacier National Parks.

KEYWORDS: phenology, Northern Rockies, Montana, Idaho, phenological events, vegetation, flora.

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The Intermountain Station, headquartered in Ogden, Utah, is one of eight regional experiment stations charged with providing scientific knowledge to help resource managers meet human needs and protect forest and range ecosystems.

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